What is claimed is:

Claims:

1. A method of fabricating an alternating phase shift mask, comprising:
forming a layer of a phase shift mask material on a handle substrate;
patterning the layer to form a plurality of phase shift windows in the phase shift mask material; and
transferring the patterned layer from the handle substrate to a mask blank to construct the alternating phase shift mask.

2. The method of claim 1 wherein a thickness of the layer and an index of refraction of the phase shift mask material are selected to provide a phase shift of approximately 180° for electromagnetic radiation transmitted through the plurality of phase shift windows relative to electromagnetic radiation transmitted through regions of the phase shift mask material between the plurality of phase shift windows.

3. The method of claim 1 further comprising:
depositing an opaque material on the patterned layer; and
patterning the opaque material to form an opaque feature.

4. The method of claim 3 wherein the opaque material is chromium.

5. The method of claim 3 wherein the opaque feature is selected from the group consisting of an exposure field border, alignment marks, wide pattern features, and sidewall spacers for the plurality of phase shift windows.

6. The method of claim 1 wherein forming the layer of the phase shift mask material further comprises:

depositing the phase shift mask material on the handle substrate to form the layer.

7 The method of claim 1 wherein forming the layer further comprises:

growing the phase shift mask material from a surface thickness of the handle substrate to form the layer.

8. The method of claim 7 wherein the handle substrate is silicon and the phase shift mask material is silicon oxide.

9. The method of claim 8 wherein growing the phase shift mask material comprises:

thermally oxidizing the silicon handle wafer to grow silicon oxide.

10. The method of claim 1 wherein transferring the patterned layer comprises:

etching the handle substrate until removed from the phase shift mask material without modifying a thickness of the layer.

11. The method of claim 10 wherein the handle substrate is silicon and the phase shift mask material is silicon oxide, and etching the handle substrate comprises:

etching in an aqueous wet etchant solution containing potassium hydroxide.

12. The method of claim 1 wherein patterning the layer comprises:

removing portions of the phase shift mask material so that the plurality of phase shift windows extend completely through a thickness of the layer.

13. The method of claim 12 wherein the thickness of the layer and an index of refraction of the phase shift mask material are selected to provide a phase shift of approximately 180° for electromagnetic radiation traversing the plurality of phase shift windows.

14. The method of claim 1 wherein the mask blank is formed from quartz and the phase shift mask material is selected from the group consisting of quartz and silicon oxide.

15. The method of claim 1 wherein transferring the patterned layer comprises:

contacting the patterned layer with the mask blank to establish a substantially planar interface;

bonding the phase shift mask material to the mask blank at the interface; and

removing the handle substrate from the patterned layer.

16. The method of claim 15 wherein bonding the layer to the mask blank comprises:

heating the interface to a temperature effective to cause fusion bonding.

17. The method of claim 15 wherein removing the handle substrate comprises:

etching the handle substrate selective to the phase shift mask material and the mask blank.

18. The method of claim 1 further comprising:

reducing the area of the patterned layer before transferring the patterned layer from the handle substrate to the mask blank.

19. The method of claim 18 wherein reducing the area comprises:

cleaving the patterned layer to reduce the area.

20. The method of claim 18 wherein reducing the area comprises:

dicing the patterned layer to reduce the area.

21. The method of claim 18 wherein a thickness of the layer and an index of refraction of the phase shift mask material are selected over the reduced area to provide a phase shift of approximately 180° for electromagnetic radiation traversing the phase shift windows.

22. The method of claim 1 wherein patterning the layer comprises:

etching the layer with an anisotropic etch process for a time sufficient to form the plurality of phase shift windows.

23. The method of claim 1 further comprising:

isotropically etching the handle substrate selective to the phase shift mask material using the plurality of phase shift windows as a mask to form undercut regions in the handle substrate extending beneath each of the plurality of phase shift windows.

24. The method of claim 23 further comprising:

filling the undercut regions in the handle substrate with an opaque material to form a plurality of spacers each proximate to a perimeter of a corresponding one of the plurality of phase shift windows.

25. The method of claim 24 wherein filling the undercut regions comprises:

depositing a conformal film of the opaque material over the patterned layer; and

removing the conformal film with the exception of the opaque material present in the undercut regions.

26. The method of claim 23 wherein etching the handle substrate comprises:

etching in an aqueous wet etchant solution containing potassium hydroxide for a time sufficient to form the undercut regions.

27. An alternating phase shift mask produced by the process comprising:

forming a layer of a phase shift mask material on a handle substrate;

patterning the layer to form a plurality of phase shift windows in the phase shift mask material; and

transferring the patterned layer from the handle substrate to a mask blank to construct the alternating phase shift mask.

28. The alternating phase shift mask of claim 27 wherein a thickness of said layer and an index of refraction of said phase shift mask material are selected to provide a phase shift of approximately 180° for electromagnetic radiation traversing said plurality of phase shift windows.

29. The alternating phase shift mask of claim 27 further comprising:

an opaque feature of an opaque material on said patterned layer.

30. The alternating phase shift mask of claim 29 wherein said opaque material is chromium.

31. The alternating phase shift mask of claim 30 wherein the opaque feature is selected from the group consisting of an exposure field border, alignment marks, wide pattern features, and sidewall spacers for the plurality of phase shift windows.

32. The alternating phase shift mask of claim 27 wherein said phase shift mask material is deposited on said handle substrate to form said layer.

33. The alternating phase shift mask of claim 27 wherein said phase shift mask material is grown on said handle substrate to form said layer.

34. The alternating phase shift mask of claim 33 wherein said handle substrate is silicon and said phase shift mask material is silicon oxide grown by oxidizing said handle substrate.

35. The alternating phase shift mask of claim 27 wherein said mask blank is formed from quartz and said phase shift mask material is selected from the group consisting of quartz and silicon oxide.

36. The alternating phase shift mask of claim 27 wherein said mask blank is substantially optically transparent and said phase shift mask material is substantially optically transparent.

37. A structure for forming an alternating phase shift mask comprising:

a handle substrate;

a mask blank; and

a layer of a phase shift mask material disposed between said handle substrate and said mask blank, said layer including a plurality of phase shift windows extending through said phase shift mask material, and said layer characterized by a thickness and said phase shift mask material characterized by an index of refraction selected to provide a phase shift of approximately 180° for electromagnetic radiation traversing said plurality of phase shift windows.

38. The alternating phase shift mask of claim 37 wherein said phase shift mask material is deposited on said handle substrate to form said layer.

39. The alternating phase shift mask of claim 37 wherein said phase shift mask material is grown on said handle substrate to form said layer.

40. The alternating phase shift mask of claim 39 wherein said handle substrate is silicon and said phase shift mask material is silicon oxide grown by oxidizing said handle substrate.

41. The alternating phase shift mask of claim 37 wherein said mask blank is formed from quartz and said phase shift mask material is selected from the group consisting of quartz and silicon oxide.

42. The alternating phase shift mask of claim 37 wherein said mask blank is substantially optically transparent and said phase shift mask material is substantially optically transparent.

43. An alternating phase shift mask comprising:

a mask blank having a first surface;

a layer of a phase shift mask material disposed on said mask blank, said layer including a second surface confronting said first surface and a plurality of phase shift windows extending through said phase shift mask material, said layer characterized by a thickness and said phase shift mask material characterized by an index of refraction selected to provide a phase shift of approximately 180° for electromagnetic radiation traversing said plurality of phase shift windows; and

a fused interface joining said first surface of said mask blank with said second surface of said layer.

44. The alternating phase shift mask of claim 43 wherein said mask blank is formed from quartz and said phase shift mask material is selected from the group consisting of quartz and silicon oxide.

45. The alternating phase shift mask of claim 43 wherein said mask blank is substantially optically transparent and said phase shift mask material is substantially optically transparent.

46. The alternating phase shift mask of claim 43 further comprising:

an opaque feature of an opaque material on said patterned layer.

47. The alternating phase shift mask of claim 46 wherein said opaque material is chromium.

48. The alternating phase shift mask of claim 46 wherein the opaque feature is selected from the group consisting of an exposure field border, alignment marks, wide pattern features, and sidewall spacers for the plurality of phase shift windows.